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Warm-Up | Continental Drift

Lesson Question

How are Earth's continents related?

Lesson Goals

Explore the relationships among the continents.

Explain continental drift.

Describe evidence that supports continental drift.

Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

C fossil

A theory

B continental drift

A. a well-tested, widely accepted explanation that combines several hypotheses and observations

B. the gradual movement of the continents across Earth's surface over time

C. a trace of an ancient organism preserved within a layer or rock

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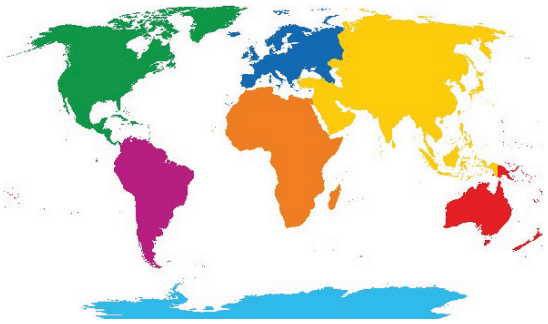
Continents

Earth is covered with [landmasses] called continents.

- Earth has seven continents: North America, South America, Antarctica, Europe, [Asia], Africa, and [Australia].
- The continents make up just one-third of Earth's surface. The rest of Earth is covered with [water].



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Early Exploration of the World

Voyages by early European explorers changed the world map.

- Europe, Asia, and Africa were known and mapped.
- Christopher Columbus and other explorers reached the New World.
- North and South America were added to maps.
- People noticed that the continents looked like they could fit together.

Alfred Wegener (1880–1930)

Alfred Wegener:

- was a German scientist.
- proposed that the continents move.
- believed all continents were once connected as a large landmass.
- hypothesized that the continents drifted apart over a long period.
  - This became known as the **theory** of **continental** drift.

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The Theory of Continental Drift

Wegener believed the continents were once one large landmass rather than [separate] landmasses.

- 300 million years ago, the continents were one giant landmass called [Pangaea].
- Over time, pieces of the landmass broke apart and drifted.

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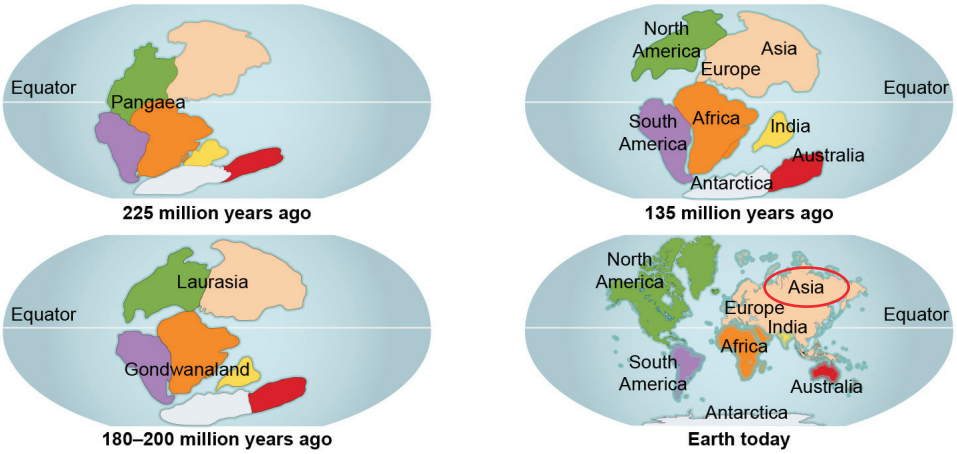
The Theory of Continental Drift

On the globe, circle the continent that crashed with India.



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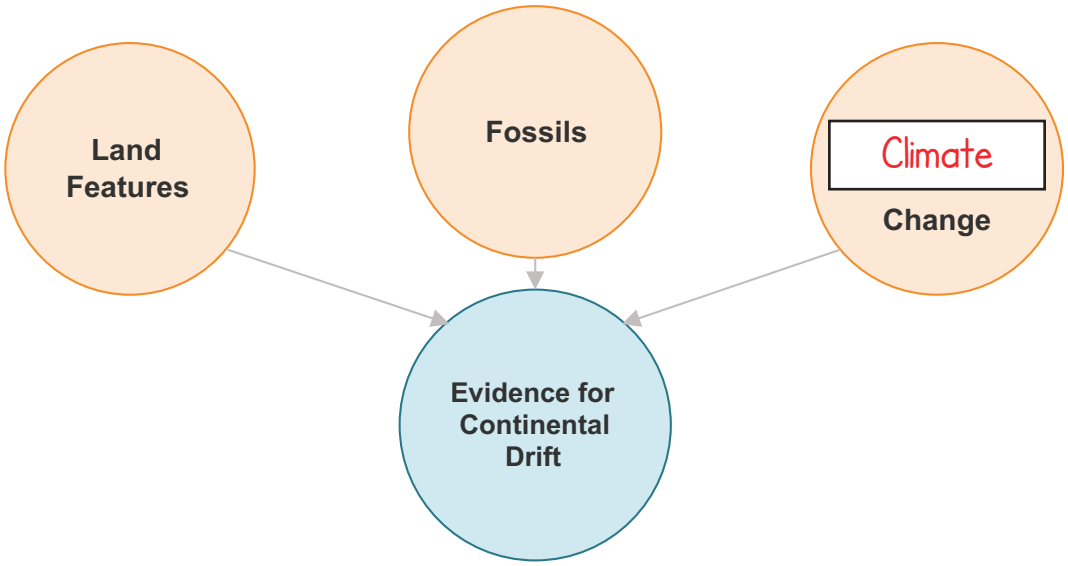
Evidence for Continental Drift



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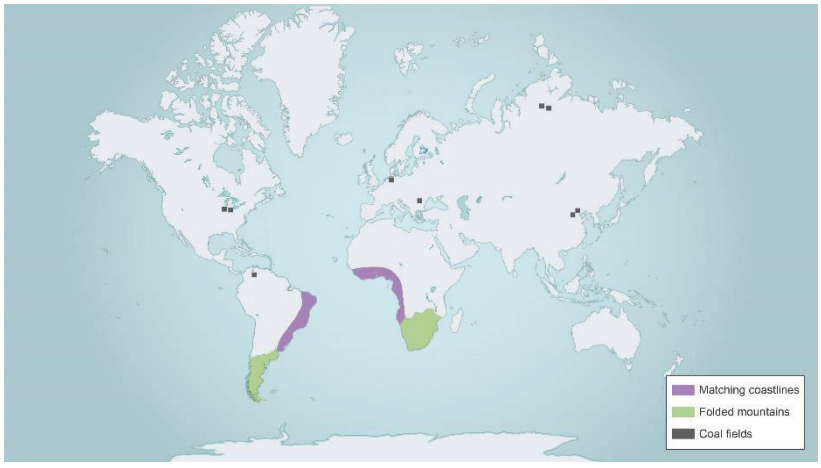
Evidence from Land Features



The mountain ranges near Buenos Aires match up with the mountain ranges in South Africa. It is also true for the mountain ranges in Europe and North America.

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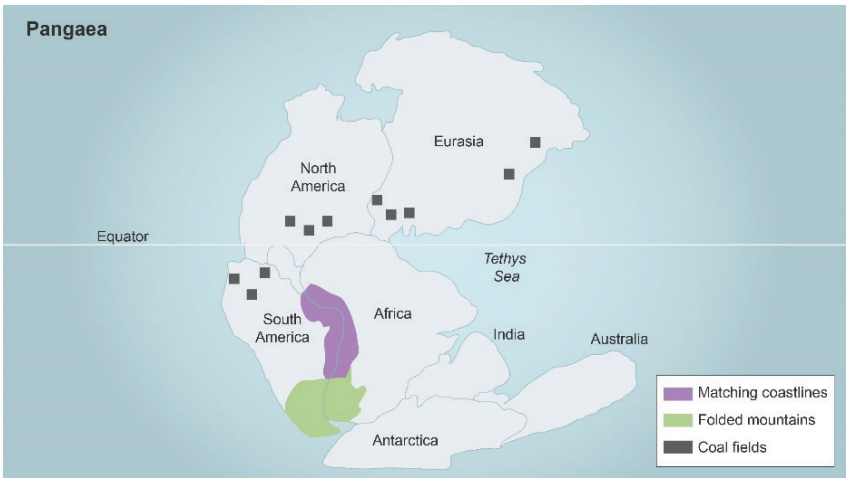
Evidence from Land Features



Wegener's evidence led him to believe that the continents were once one massive landmass. The landmass has been named Pangaea.

Evidence from Fossils

On the map, circle the region where fossils of Lystrosaurus were found.



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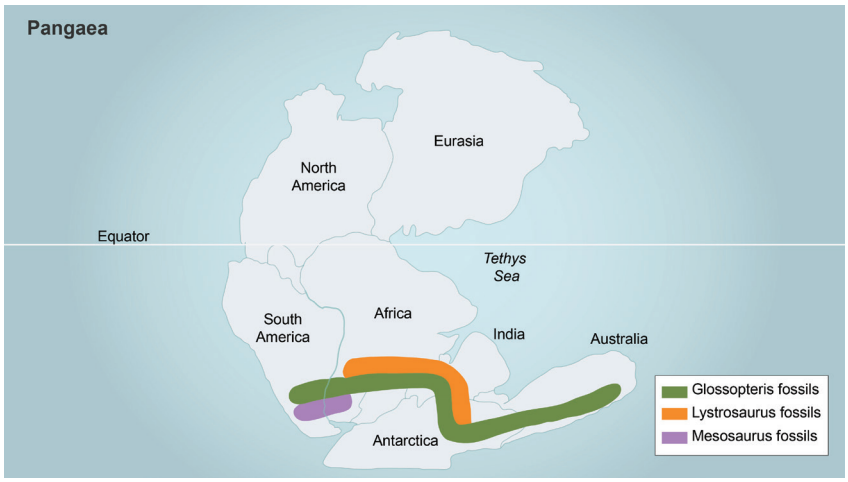
Evidence from Fossils



Wegener's belief that these plants and animals lived on the same [landmass] now makes sense. The fossils are in the same area.

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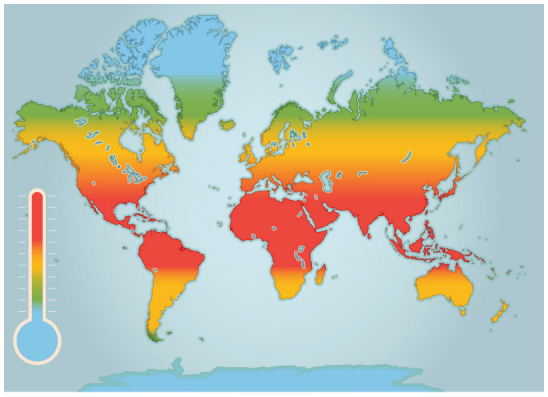
Evidence from Climate Change

Wegener also used evidence from climate change to support [continental drift].



- Warmer climates are near the [equator].
- Colder climates are near the [poles].
- [Tropical] plant fossils have been found on arctic islands.
- Evidence of [glaciers] has been found in South Africa.

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Wegener and the Scientific Community

Wegener's theory was originally rejected by the [scientific] community.

- Wegener had no evidence for what pushed and pulled the continents.
- Wegener and geologists also disagreed about how continents formed.
  - Geologists thought mountains formed due to [Earth] shrinking.
  - Wegener countered that [mountains] would be found everywhere.
  - Wegener believed they formed when [continents] collided.

Wegener's theory of continental drift was finally accepted in the 1960s.

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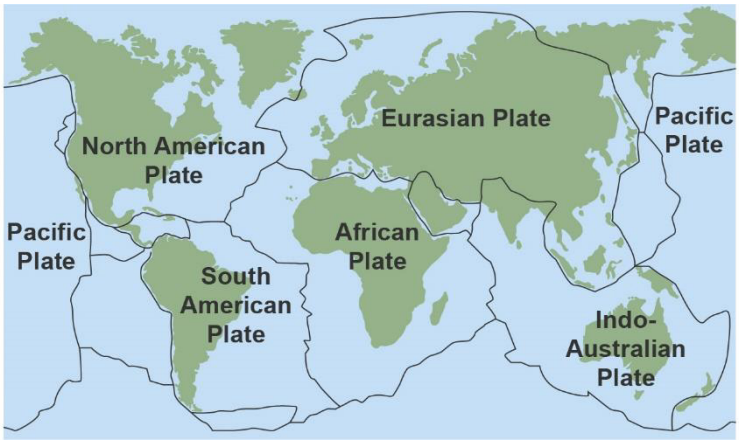
Earth's Plates



The continents of Earth sit on giant masses of [rock] called plates. The plates of Earth are pictured here.

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Plate Movement

Plates move constantly but [slowly].

- Plates can move [away] from each other and form valleys and new ocean floor.

- Plates can [bump] into each other and form volcanic mountains, volcanic [islands], or mountains.



- Plates can move [past] each other and form thin valleys or narrow breaks in the [crust].

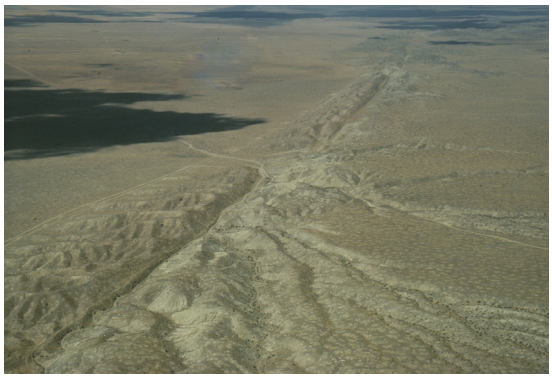

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Plate Motion Predictions

Scientists have studied the motion of the [tectonic] plates using rocks on the seafloor.

- This information can be used to predict:
  - [future] motions of tectonic plates.
  - locations of plates, geologic features, or landforms.
  - resulting geologic features from plate [interaction].

Rate of Plate Motion

The [rate] of motion can be used to describe a plate's movement.

- Rate describes the distance a plate moves in a certain period of time.
  - Distance is the [length] between two points.
  - Time is the measured period between the beginning and end of an action or process.

$$\text{Rate} = \frac{\text{distance}}{\text{time}}$$

$$\text{Rate unit} = \frac{\text{centimeters (cm)}}{\text{year}}$$

$$\text{Rate unit} = \frac{\text{meters (m)}}{\text{year}}$$

$$\text{Rate unit} = \frac{\text{kilometers (km)}}{\text{year}}$$

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A plate moves 400 m in 20,000 years. What is its rate in cm/year?

- Information given:
  - Distance: 400 m
  - Time: 20,000 years
- Information to be determined:
  - Rate in cm per year

- Rate $= \frac{\text{distance}}{\text{time}}$

$= \frac{400\text{ m}}{20{,}000\text{ years}}$

$= 0.02\frac{\text{m}}{\text{year}}$

- Convert m to cm:
  $0.02 \times 100 = 2$ cm
- Rate: $2\frac{\text{cm}}{\text{year}}$

Answer: The plate moves at a rate of $2\frac{\text{cm}}{\text{year}}$.

Time and Distance Calculations

The rate equation can be used to calculate distance and time.

To find distance, multiply rate by time.

Distance = rate × time

To find time, divide distance by rate.

Time $= \frac{\text{distance}}{\text{rate}}$

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Distance and Location Sample Problem

If a plate moves at a rate of $3\frac{\text{cm}}{\text{year}}$ toward the north, where would the plate be in 5,000 years? Express your answer in meters.

- Information given:
  - [Rate]: $3\frac{\text{cm}}{\text{year}}$ to the north
  - Time: 5,000 years
- Information to be determined:
  - Distance/location

- Distance = rate × time

$$= 3\frac{\text{cm}}{\text{year}} \times 5{,}000 \text{ years}$$

$$= 15{,}000 \text{ cm}$$

- Convert cm to [m]: $\frac{15{,}000}{100}$
- Distance: 150 m
- Answer: The plate would be 150 m north of its original location.

Time Calculation Sample Problem

A plate moving at a rate of $2\frac{\text{cm}}{\text{year}}$ is moving toward a plate that is 1,600 km away. In how many years will the plates collide, and what geologic feature(s) will be formed?

- Information given:
  - [Rate]: $2\frac{\text{cm}}{\text{year}}$
  - Distance: [1,600] km
- Information to be determined:
  - [Time] of collision and geologic features formed

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Time and Geologic Feature Sample Problem

A plate moving at a rate of $2\frac{\text{cm}}{\text{year}}$ is moving toward a plate that is $1{,}600$ km away.

In how many years will the plates collide, and what geologic feature(s) will be formed?

- $\text{Time} = \frac{\text{distance}}{\text{rate}}$

  $= \frac{1600\,km}{2\,cm/year}$ → Convert $1{,}600$ km to [cm]:

  $1{,}600 \times 100{,}000 = 160{,}000{,}000$ cm

  $= \frac{160{,}000{,}000\text{ cm}}{2\text{ cm/year}} = 80{,}000{,}000$ years

- The [plates] will collide in 80 million years. [Volcanic] mountains, volcanic islands, or mountains may form.

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Summary | Continental Drift

Lesson Question

How are Earth's continents related?

Answer

(Sample answer) Alfred Wegener proposed the theory of continental drift, which states that continents were once a large landmass called Pangaea. Over time, this large landmass broke up and the pieces drifted apart, forming the continents we now see.

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Review: Key Concepts

The theory of continental drift states that the continents were once a large landmass that drifted apart over time. Evidence includes the following:

Land Features

- [Coastlines] fit together
- [Mountains] lined up across continents
- Coal fields matched up

Fossils

- [Plant] fossils found on different continents
- Fossils of animals that could not swim found across [oceans]

Climate Change

- [Tropical] plant fossils found on arctic islands
- Evidence that [glaciers] once existed in South Africa

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Use this space to write any questions or thoughts about this lesson.

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